APPLE II
UTOPIA GRAPHIC TABLET SYSTEM
BY
UTOPIA SOFTWARE DEVELOPMENT

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INTRODUCTION

This system of Applesoft and machine language programs is designed to take maximum advantage of Apple's high-resolution graphics capabilities as controlled by the Apple Graphics Tablet. The key feature of the system is its highly interactive nature. Once the basic conventions are understood, there is little need to refer to the manual. All possible options are presented on the screen and selected with the pen-controlled cursor. There are no menu overlays or keyboard commands so one's eyes need never leave the screen.

Aside from the obvious necessity of possessing an Apple Graphics Tablet, the system requires 48K RAM, Applesoft in ROM, or Language Card, and at least one disk drive. You may also want to keep a supply of empty or partially empty initialized disks for extra storage of pictures, full color brushes, shapes and animation routines.

To start the system, simply boot the disk. The startup program finds the graphic tablet interface card (or tells you if it can't), reallocates the memory to protect the canvas area, loads shape tables, hi-res text generator and machine language utility programs and runs the main program.

System Conventions

The UTOPIA System is what is known as a menu-driven system; that is, all possible options are presented to the user on the screen and a selection is made using the cursor as contolled by the stylus of the graphic tablet. This eliminates the need to memorize more than the meaning of the commands, most of which are self explanatory.

Calling the Menu

The main program and all of the sub-programs have at least one menu - the "primary" menu which directs you to the other parts of the program. Whenever the cursor appears on the screen, the primary menu may be recalled by moving the cursor off the TOP of the screen and pressing the pen down (called "polling"). All of the sub-programs have a command called MENU which returns you to the main program (PAINTBOX). Some programs may have several menus. Polling off the top will eventually bring you to the outermost menu.

Disk Messages

Certain parts of the system will request that you insert a Storage disk in the drive before the program proceeds. It is not necessary to remove the System disk before pressing the RETURN key. However, if you plan to save or retrieve files from another disk, this is a good time to change disks.

The Palette

When the system is first initiated, the paint color defaults to WHITE1. Some parts of the program require a color selection before proceeding. Once you begin working on the screen (or "canvas"), you may wish to recall the palette so you can change colors. This is accomplished by moving the cursor off the RIGHT side of the screen and pressing the pen down. With a little practice, these movements will become more or less automatic and will enable you to work much more quickly than if you had to shift your eyes from the screen to the tablet or the keyboard every time you wanted to change something.

The Grid

Any of the functions that require points to be specified (Rectangles, Circles, Lines, Active Screen Area) allow you the option of calling the "Grid", a piece of "electronic graph paper" that is superimposed over the canvas to give you points of reference. Before specifying a point, move the cursor off to the LEFT and press. The Grid will appear with a star marking the exact center of the screen. Determine the location of the point, press, and the Grid will disappear, leaving the screen in it's original condition.

NOTE: The graphics tablet hardware is susceptible to static discharges that may cause the system to occasionally misread a command, sending you to an unwanted operation or giving erroneous results. In most cases, a return to the menu and a reselection will net the desired results. Consult the Apple Graphics Tablet Manual for more information about static and how to deal with it.

Paintbox

PAINTBOX is the name of the main program. All of the other programs in the system are called from here and return here before another program can be reached. Perhaps this is a good time to explain the purpose of some of the programs before we get into the intricacies of the system.

Paintbox: Gives you a menu of painting "tools" and techniques for placing color onto the Apple hi-res screen (sometimes referred to herein as the canvas).

Make-a-Brush: Lets you draw and save pictures in color on a 40 by 48 low resolution screen and shrink and place them onto the canvas. Also enables you to blow up a 40 by 48 pixel (dot) area of the canvas and make changes on it, save it, and replace it in another area of the canvas.

Shaper: Allows you to create and save shape tables, define the scale and rotation of shapes and place or paint them onto the canvas.

Fill-In: Gives you an expanded palette with which you can fill enclosed areas of the canvas. Also gives you a special brush which paints in the colors of the expanded palette; allows you to replace colors on the canvas with other colors; draws boxes, circles and ellipses, either empty (outlined) or filled with color.

Global Options: Performs a number of operations on the full canvas area. See full program description for details.

Label/Graph: Lets you put upper and lower case characters anywhere on the canvas or "paint" characters with the stylus. Also enables you to plot bar graphs, pie charts, and cartesian graphs utilizing user-defined math functions.

The Gallery: Lets you name, save and recall canvasses and "tour" the gallery.

Digitize: Allows the calibration of the tablet and measurement of distances and areas.

Animate: Assembles a sequence of up to 100 events that can be edited, saved and replayed to execute automatically.

New Frame: Outlines the full screen area in the selected color.

New Canvas: Clears the canvas to the selected color either inside or outside of a preset active screen area.

The Canvas

The canvas is the area of Apple memory known as HGR2 (locations 16384 through 24575). This area is not used for any other purpose than picture display except in the case of ANIMATE which, because of memory requirements, writes over the canvas area. If you enter the command to ANIMATE you will first receive a warning so you can save the canvas first. There are only two other conditions under which the canvas can be erased: if you enter the command "New Canvas" from PAINTBOX or if you are using the Plot option in LABEL/GRAPH. In either case, erasure can be aborted when the palette appears by moving the cursor off the top of the screen and pressing the stylus down, recalling the main menu.

Getting Started

When the system is first started up, the canvas is usually full of garbage. You have two options at this point: go to THE GALLERY and load an old picture or start fresh on a new canvas. Let's assume we are starting from scratch. Position the cursor over the command "New Canvas" and press the stylus down. When you lift the pen up again (the system does not execute the command until the pen is raised) the menu will disappear and two words will appear on the screen: "Inside" and "Outside". This means inside or outside of the "Active Screen Area", an option that is explained more fully at the end of the chapter. When the system is booted up the active screen area is set for the full screen, so move the cursor to the side that says "Inside" and press the pen down. The screen will again erase itself and a palette of 8 "colors" will be drawn. The word "colors" is in quotes because, as anyone who has experienced trying to use Apple's color graphics has learned, the Apple has a very unusual method for creating what "appears" to be color on a color TV screen. This is why there are two blacks and two whites in the palette (for further explanation of this system see the GRAPHICS TABLET Manual that comes with the tablet). To clear the canvas, simply choose a color in the same way that you chose the other commands: position the cursor and press down on the pen. The screen will be cleared to that color and you will be returned to the main menu.

Viewing the Canvas

If you are ever at the main menu level and want to take a look at the canvas, simply move the cursor off the right side of the screen and press. The canvas area will appear and remain until you press the pen down again, returning you to the menu.

Framing the Canvas

Suppose you have just cleared the canvas to one of the blacks. Since the canvas does not fill the whole screen of the TV, it's hard to tell where the canvas ends and the unused part of the TV screen begins. If you choose "New Frame" from the menu, you can surround the canvas with a border of any of the available colors. The frame surrounds the whole canvas, not just the active area, so you don't get an Inside-Outside option between the menu and the palette.

The Brushes

We are now ready to do some painting. Choose "Paintbox" from the menu. A list of "brushes" will appear on the screen. The first ten brushes are pre-defined functions and the next twelve are pre-drawn shapes with special functions of their own. "Filigree" and "Special Options" apply to these shapes and will be explained in full shortly. Here is a run down of the capabilities of the brushes:

Sketch: This is a simple drawing function more or less identical to the "draw" function that comes with the original tablet software. As noted under System Conventions, the palette can be recalled by moving the cursor off the right of the screen and pressing. Remember, the main menu is recalled by moving off the top and pressing.

Points: Just like "dots" in the original tablet software.

Dribble: Draws with a slightly "messy" line that resembles a quill pen.

Smear: This brush requires a bit of special technique to be effective. The brush is "smeared" around in a circular motion over a small area of the picture, usually the border between two distinct colors or shapes. The hard edges will become smeared together, giving the borders a textured look. There is no color selection involved with this brush.

Airbrush: When you call this brush, a blank screen with the word "Area<^>" at the bottom appears. As you move the stylus across the tablet, a dot will flash around the center of the screen. If you move the pen from left to right, the dot will flash over a larger horizontal area; if you move from bottom to top, the dot will flash over a larger vertical area. This is the area of the "spray" of the airbrush. Press the pen down when the spray is the desired size and shape to move on to the canvas.

Finger Paint: This brush simulates the technique of finger painting by combining the color chosen from the palette with its "complement". For example, if you choose green, it will be combined with blue.

Lines: This function draws lines between two specified endpoints. After you specify the first point, the system goes into "rubber band" mode; that is, a line will stretch out from the first point to the cursor position and follow the cursor until you press the pen down to specify the second

point. The line is then drawn in the selected color. The method here also differs from the original tablet software in that each line segment requires two separate endpoints rather than using the last point as the new first point.

Splines: In this system, "splines" is short for "special lines". When you choose splines you have three options:

> Fixed: The first point is specified when the pen is first pressed down and as the pen is moved, new points are specified and lines connected between these and the first point, until the pen is lifted.
>
> Continuous: Line segments are connected end to end as the pen specifies new points.
>
> Broken: Line segments are drawn between every other set of points specified. The line segments are long if you draw fast and short if you draw slower.

Rectangles: This function, identical to "frame" in the original software, draws unfilled rectangles from points specifying the opposite corners.

Circles: First you specify the center of a circle, then the radius. The rest is automatic. Although it may take a while, the program is checking to see if the circle runs off the screen and will "clip" any part of it that does.

The rest of the list (pixelTHROUGH dry brush) are the names of shapes stored in memory. When you choose one, the canvas will appear and a lot of lines will start flashing all over it. If you move the pen towards the bottom of the tablet, the lines will begin to shrink until you reach a point where they stop shrinking. If you move the pen from left to right, the lines (or dots, if the scale is small enough) will change rotation. When you get the scale and rotation you want, press the pen down and it's all set. The reason why this is done on the canvas is so you can match the scale and rotation of the shape to some object already drawn. When the palette appears, you will see another box just below the strip of colors labeled "XDRAW". If you press the pen down in this box, the shape will be drawn as a complement to whatever is under it ("XORed" for the technically minded).

Filigree: If you press Filigree before you choose one of the shapes, then an interesting thing happens when its time to draw; start drawing in the upper-left corner of the canvas and the shape will also be drawn in the other three corners! Move toward the center and all the shapes will move as well in perfect symmetry.

Special Options: Press here before you choose a shape and you get a choice of the following:

> Cycle-paint: The shape will cycle through the entire palette of colors as you paint.

Spin: The shape will change rotation automatically as you paint.

Dyna-size: After the rotation is set (scale is irrelevant) the shape will appear on the screen with the words "shrinking from" or "expanding to" at the bottom. If you move the pen to the left or right the words will change, up and down and the scale of the shape changes. If you press down with the words "shrinking from" the shape will shrink from the scale you set to the smallest scale as you draw. If the screen says "expanding to" when you press then the shape will expand from the smallest scale to the scale specified.

The special options can be used separately or in any combination. The options menu will remain on screen until you select "Done" so you can choose one, two or all three options before proceeding.

Recalibration

If, from the main menu, you move the cursor off the left of the screen and press, a menu of calibration commands will appear. Some of these are similar in operation to the "window" and "viewport" commands in the original tablet software, but their implementation is somewhat more flexible. Generally, they only effect the "sketch" function, which is the one you are most likely to use for transferring drawings or graphics onto the screen.

Active Screen Area: This command sets the viewport, protecting the rest of the screen from being "sketched" upon. This boundary is also in effect when you call for a New Canvas, which can be cleared inside or outside of the active screen area. When you select this command, the screen and cursor will appear. Select the two opposite corners of the boundary, after which the corners of the boundary will be displayed. If you wish to change the boundaries before proceeding, press the pen down within the screen area and the corners will disappear, allowing you to start over. When you are satisfied, move the cursor off the left side and press. The calibration menu will reappear. The corner marks will not be displayed on the screen when you go to draw as some of the other functions may alter them, making then impossible to remove.

Active Tablet Area: This function allows you to specify an area of the tablet that will be used if you select "Expand" or "Aspect". Prompt messages displayed on the screen will instruct you to select points on the tablet, after which you will be returned to the calibration menu.

Shrink: Selecting this function will shrink the full tablet area into the active screen area.

Expand: This function expands the active tablet area to fill the full screen area.

Aspect: If you select this command, the system will (up to the limits of the tablet firmware) exactly fit the active tablet area into the active screen area. When transferring (tracing) a picture on the tablet to the screen, this can give you a picture that is squashed or stretched, a capability not available with the original software.

Normal: This sets the active screen area to the full screen and the active tablet area to the maximum, then returns you to the main menu.

NOTE: When drawing in a recalibrated mode, you may find that the cursor never leaves the screen or flies off the screen at the slightest movement. In such cases, pressing the pen down in the upper 1" of the tablet will recall the menu, and within the right 1/2" or so of the tablet will recall the palette.

When you are finished recalibrating, the main menu is recalled in the conventional manner. The recalibration values remain in effect until you change them or "Normal"-ize them. If you call another program from the main menu (any one that displays a "LOADING" message) then all values are re-normalized.

The Directory Fixer

There is one more part of the system hiding behind the main menu - a utility program that should only be necessary if you happen to confuse your storage disks and get your directories mixed up, showing files that are not on the disk or not showing files that are. This program is called by moving the cursor off the BOTTOM of the screen from the main menu and polling (pressing). After you instruct the program as to which kind of directory you want repaired, the disk will be searched for appropriate files and an updated directory will be saved to the disk. Check the Gallery section of this manual for an explanation of the storage process to see why this feature might be useful.

Make-a-Brush

This program provides an interface between the hi-res and lo-res screens, allowing you to work in detail without having to squint at a tiny area of the canvas. You can also design full color "brushes" that can be saved and painted onto the canvas, or "lift" areas of the canvas and turn them into brushes.

The Palette: There are a few practical differences between the colors of the palette and the colors that appear on the lo-res screen. If you choose one of the blacks, they will appear as either dark brown or dark green so you can keep them from getting mixed up. Likewise, the whites appear as white or pink. There is also a box on the palette labeled "TRANSPARENT". When the system moves a picture from the lo-res screen to the canvas, it skips over any block that is "transparent", leaving the canvas underneath untouched. This color appears as true black on the lo-res screen Remember, the palette can be recalled within any painting operation by moving off the right side of the screen and pressing.

Design: When you choose this command, you will first be shown the familiar palette, after which a different kind of screen and cursor will appear. Instead of the usual crosshair, the cursor looks like a flashing square and the screen (if there is anything on it) will be composed of blocks or bars of random colors. This is the lo-res screen and it can be drawn upon in the same way you draw on the canvas. To clear any garbage off the screen, choose "Options" from the menu and "Clear" from the secondary menu.

Old Brush: This command will display a directory that contains the names of any brushes you may have saved. Simply choose the brush you want and it will be loaded onto the lo-res screen where it can be altered or used to paint with.

Blow-Up: This command displays the canvas and a "cursor" of four dots that describe a 40 by 48 area of the screen. When you press the pen down, the lo-res screen will appear for a split second, and the area within the dots will be "blown up" onto it, after which the palette appears. You can then choose a color from the palette or return to the main menu to issue a "Paint" or "Disk" command. If you choose a color, the lo-res screen will reappear and anything you paint on it will be painted on the canvas at the same time.

Paint: Call this command, and the canvas will appear with the four-dot-cursor. This time, pressing the pen down causes the picture on the lo-res screen to be painted on the canvas. Since the Apple can only plot certain colors in certain places, you may sometimes get a "paint" with some of the picture missing. In most cases, this can be fixed by the "Rectify" command in the "Options" section.

Options: You have three possible options to choose from:

> Clear: This will erase the entire lo-res screen to the chosen color.

Erase: This function converts any occurence of the selected color to "transparent". For example: you have just blown up a green circle on a black background. "Erasing" black will allow you to paint the green circle without painting the background as well.

Rectify: To compensate for the Apple's tendency to only plot certain colors in certain places, "Rectify" doubles the width of colored lines on the lo-res screen. It is not advisable to rectify the screen before saving it, as it can't be un-rectifyed.

Disk: There are four disk-related commands available:

Load Directory: This command loads the directory of a non-system disk used for saving brushes.

Create Directory: This function creates a new directory on a non-system disk.

Save: First the current directory is displayed. After you choose a "slot" the system asks you for a name (10 characters or less) for the brush. Type in the name, after which the brush is saved and the directory is updated.

Dump: Lets you erase a brush from the disk and remove the name from the directory.

Menu: This command returns you to the main menu (Paintbox).

Shaper

The Shaper allows you to interactively define shapes, name theM and store theM in tables of up to 20 shapes, save and recall named tables and paint with the shapes in the same way you can with the pre-defined shapes in Paintbox. Each shape table is 2000 bytes long, allowing you define shapes of up to 2000 diagonal points or over 4000 horizontal and vertical points!

New Table: When you first enter the program there is old data and garbage in the table area. This command clears the table and sets up an index at the beginning. After a wait of about 10 seconds, you are returned to the main menu.

Old Table: Press here and a directory of previously saved tables is displayed. After a choice is made, the table and its directory of names are loaded and the main menu is displayed.

Paintbox: This is the same as Paintbox (available from the system menu) without the Special Options or Filigree functions but with one additional feature. When the palette is displayed, there are two boxes labeled "XDRAW" and "XPAINT". XPAINT is the same function that appears on the other Paintbox palette. XDRAW XOR's the shape once when the pen is pressed and not again until the pen is lifted and pressed again. With this feature you can draw a shape and then "undraw" it by centering the cursor over it and pressing.

Design: If you have just entered the program and there is no table loaded, this function first does a "New Table" and then displays a directory of shapes (if an old table is loaded then it's shape directory is displayed). Next to each entry there is a number: "50 pts." for the first ten entries, "100 pts." for the next five and "200 pts." for the last five. These numbers are not limits but "boundaries" ("pts." are the number of diagonal points). Shapes can be longer than these boundaries , even as long as the entire table if desired. Choose an entry, give it a name when requested (or press RETURN to reuse the old name and edit the old shape) and you will be set to design.

Design shows you a blank screen with a dot in the middle (or a shape if you choose an entry that already has a shape in it), a flashing "tail" that indicates the end of the shape, and a command line at the bottom that reads "PLOT MOVE EDIT DONE". The -^^- under the word PLOT indicates that you are in plot mode. To change modes, center the cursor over the command and press. At the bottom center of the screen is a number that indicates how many bytes or diagonal points are contained in the shape. Whenever you PLOT or MOVE, the point counter is incremented accordingly.

PLOT- By pressing the pen down in the area above the command line, you determine the direction in which dots are added to the shape. If you move the cursor to the top of the screen (without going out of the screen

area) and press, the "tail" dot on the screen will move up, leaving a plotted dot behind it. If you press with the cursor in a corner, the dot will move toward that corner. The dot will always move toward the cursor.

MOVE- If you select this command, the -^^- will jump under the word MOVE to indicate which mode you are in. This time, when you press the pen down within the screen area, the dot will move but will not leave a dot behind it. These locations are skipped over when the shape is drawn. Notice that the program always plots dot in the center of the screen to give you a reference. This dot is not necessarily part of your shape unless you actually started with a PLOT.

EDIT- This command causes the the dot to backtrack one space every time it is pressed, removing any dots that have been placed there and decrementing the point counter accordingly.

DONE- This command indicates that the shape is completed. The directory is updated and you are returned to the main menu.

Append: Suppose you wanted to assemble shapes from different tables into a new table. Append allows you to load tables without overlaying the table you are working on and move shapes from the old table to the new one. For example:

Execute a "New Table" and then place a disk containing the table you want to steal from in drive 1. Fetch the disk's directory by pressing "Disk" and then "Load Directory". When the main menu reappears, press "Append" and the directory will be displayed. Choose the table from the directory and when the list of brushes appears, simply choose the ones you want appended to the new table. Empty slots in the table will be filled in ascending order and when the table is full you will get a message telling you so. You can return to the main menu in the usual manner and re-call Append to load other tables. When you are finished, you can edit shapes, paint or save the new table.

Disk: These functions are identical to the disk commands in Make-a-Brush, with the exception of "Dump" which allows you to delete a single shape (Partial) from the table or erase the entire table (Total).

Fill-In

This is one of the most interesting and dangerous features of the system. It is interesting because it offers you a new range of "colors" and methods for spreading that color around. It's dangerous because if you are not careful, you can destroy parts of your picture! Play it safe and save your pictures in the Gallery before you start foolin' with Fill-in.

The Expanded Palette

Fill-In has it's own special palette of 64 "pseudo-colors", derived by alternating the 8 Apple colors on even and odd horizontal lines. For instance, aqua is alternate green and blue lines. There are actually two aquas, one with the blue on even lines and another with the green on even lines. This is so you can paint the greatest number of combinations while avoiding the anomalies associated with Apple's color system. In the palette, vertical bars are on even lines and horizontal bars are on odd lines. To avoid problems, try to use colors that are along the same vertical or horizontal bar when painting colors that share boundaries.

Fill: This function will fill in an enclosed area of uniform color with the color selected from the expanded palette. Simply press the pen down with the cursor inside the area you want to fill. The program will sample the color at that point, search up till it runs out of that color, search down until it runs out, and then replace lines of that color from the top boundary to the bottom. This may leave unfilled areas in complicated shapes. The program could fill these areas automatically, but this increases the possibility of the fill color "spilling" out of a small hole and spreading all over the canvas. It is a simple matter to specify new points to fill. If you want to stop the filling process before the boundaries are reached, press the space bar and the cursor will return. You can fill most shapes several times, but the fewer times, the better because you risk "fraying" the boundaries, making spills possible.

Replace: If you should happen to have a spill, Replace will allow you to replace the spill with the original color. First the non-extended palette appears so you can choose the color you want to replace. Then the words "REPLACE WITH" will prompt you to choose a replacement color. Boxes will appear around "preferred" colors, those that will cause the least problems with anamolies; you don't have to use them. You can then choose to replace the full screen or a "window". If you choose the latter, specify the opposite corners of the area and the replacement is confined.

Sketch: This is the same as Sketch in the Paintbox.

Paint: This special brush allows you to paint with the colors of the extended palette. Its especially good for touch-ups and small areas.

Boxes: You can draw rectangles, just like in Paintbox. You can also draw solid boxes of any color available in the extended palette.

Circles: This gives you empty and filled circles.

Ellipses: With this function, you can draw ellipses of any size and shape, inclined at any angle. Choose a center point, then the major axis (the length), which is also the angle of inclination, and then the minor axis (width). Because of the complicated mathematics involved, filled ellipses can only be drawn in the non-extended palette colors. However, you can draw empty ellipses and fill them afterward.

Global Options

"Global" means that these functions operate on the entire screen area. That means that you may want to save any picture you may be working on because it will probably be irretrievably altered if you are not careful. Some of the functions create textures or patterns across the entire screen, so this might be a good place from which to start a new picture.

Dither: Suppose you have a picture that seems just a little too neat (heaven forbid) and you want to fuzz it up a little. Dithering adds the fuzz. Press the pen down once and it's dithered, again and it's undithered.

Rotate: For every press of the pen, Rotate bumps the colors of the picture up one palette position. That is, green becomes violet, orange becomes blue, etc. Eight rotations and you are back to the original colors.

Roll: This function resembles "SLIDE" in the original Tablet Software. Position the cursor in an area of the screen and press. The picture will move in that direction as long as the pen is held down.

Flip: First choose a vertical or horizontal flip. Then every press of the pen flips the picture upside down or sideways.

Mirror: After choosing a vertical or horizontal mirror, you must specify the opposite corners of the mirrored area. The direction of the mirroring will depend on which corner you specify last. For instance, if you choose a vertical mirror and specify the bottom corner of the area last, the top half of the area will be mirrored into the bottom half.

Spatter: This function gives you a few options in the way dots are spattered across the screen. Distribution can be random or regular. If you choose "regular", then you must specify a vertical and horizontal density, whereas random distribution requires only one density specification. When it's time to choose a color, you can also select a random color scheme.

Splatter: Splattering is just like spattering except the spots are wider (a byte wide instead of a bit wide).

Reticulate: Press the pen down and move it horizontally across the tablet. Vertical bars of different widths and colors will flash across the canvas (obliterating anything that might have been there). Lift the pen when you see the combination you want.

Kaleidoscope: This function will take anything that is on the screen and, through a series of automatic mirrorings, turn it into a symmetrical pattern. Eventually the process will stabilize but it can be stopped at any time by pressing the pen and restarted by pressing again. You must also keep the pen in proximity to the tablet or the process will stop.

Fireworks: First you will be asked to specify a speed for the fireworks. The slower the speed, the more dense the patterns. As with Kaleidoscope, pressing the pen starts the process and pressing again will stop it.

Label/Graph

Most of the other programs in the system are interactive tools for the "artistically" minded. This program, especially GRAPH, is more of a practical utility. LABEL is simply a method for you to put text on the canvas. GRAPH lets you define three different kinds of graphs, and in one particular case, define a complex mathematical function and have it plotted automatically.

There are three possible label-printing modes available: White-on-Black, Reverse, and Black-on-White. W-O-B and B-O-W print characters within a square of the background color (black and white, respectively), thereby erasing some of the picture surrounding each character. Reverse XOR's the character with the screen contents, which will not affect the area around the character. However, if characters in this mode are printed over complex or colored backgrounds, or if different characters are printed over old ones, the results tend not to be readable (you may even have some use for the cryptic symbols that can be created).

Once you have chosen a print mode, simply position the cursor where you want the text to start and press the pen down. The cursor will disappear, allowing you to enter text from the keyboard until you press RETURN, at which time the cursor reappears. Take note that if you type off the end of the canvas, the text will wrap around to the left side and eventually back to the top of the canvas.

You will notice that the text is in lower case. To get one upper case character, hit ESCAPE once. To get all upper case (shift-lock), hit ESCAPE twice, and once again to return to lower case. You will also notice that the left and right arrow keys do not forward and backspace, but print left and right arrows. To correct mistakes, hit RETURN and position the cursor over the offending character, press, and re-enter it.

Character Paint: After you've chosen a print mode, position the cursor and press. While holding the pen down, type a character on the keyboard (remember to hit ESCAPE first for capitals). Now as you move the pen around the tablet, the chosen character will be "painted" across the canvas. Change characters at any time the pen is down just by typing them.

GRAPH: Before a graph mode is selected, you must decide whether to start on a clean canvas or plot over whatever happens to be there (a colorful background, perhaps). You can also continue plotting in whatever mode you were previously working in by pressing "Plot" (nothing will happen if you haven't started plotting yet). Graphs come in three flavors:

BAR GRAPH- Upon choosing this mode, you will be asked to specify a color for the X,Y axis of the graph (something other than the background color or it won't be visible). Next, you must choose

the point at which the axes (plural of axis) meet. On a bar graph, there are no negative values so the axes only extend upwards (Y) from the nexus and to the right (X). ThereforE, it is a good idea to put the intersection somewhere in the lower-left of the canvas or you won't have any room to plot. You can specify this point in two ways: with the pen and tablet, in the usual way, or from the keyboard. To activate the keyboard, move the cursor off to the LEFT and press. In either case, the X and Y values are displayed at the bottom of the screen. The range of these values is the full resolution of the hi-res screen (X=0-279,Y=0-191).

The next step requires a specification of the number of divisions along the axes. This is accomplished in the same way the intersection of the axes was determined. For example, if X=10 and Y=20 then there will be 10 divisions along the X axis and 20 divisions along the Y axis. Then you must decide if you want horizontal or vertical bars (simple enough). After this, enter the width of the bars by moving horizontally UNTIL the readout is correct, or by using the keyboard in the manner mentioned previously. Now you are ready TO plot!

The position and length of a bar are determined by two points. The first point determines the bottom of the bar (the left side on a horizontal bar) and also it's position along the axis. The second point determines the length of the bar. For example, suppose you are plotting vertical bars on a graph whose X and Y axes each have ten divisions (representing "weeks" on the Y axis and "dollars" on the X axis). You want to represent how much money you made (or lost) on the third week. You move the cursor to the third division along the Y axis and press the pen down (a small dot will appear). If each notch on the X axis represents 100 dollars, and you made five hundred dollars that week, then you move the cursor to the fifth division on the X axis and press. A bar will be drawn 5X divisions long, ending on the third Y division.

You can change the bar colors by recalling the palette as usual, and you can return to the main menu and add text to the graph. To continue plotting, press GRAPH and when the "Clean Canvas?" prompt comes up, press "Plot".

COORDINATE- This function plots Cartesian type graphs. Specifying the axes and divisions is the same as for Bar graphs, except that the axes extend in positive and negative directions, so the intersection should be closer to the center of the screen. Once the axis is determined, you have a choice of two different plotting methods.

Interactive: This method allows you to specify points with the pen while viewing the canvas.

Defined Function: If you choose this method, you will be shown a list of available functions that can be

combined in any acceptable algebraic formula that can be expressed as a function of Y (Y=**your formula here**). You may also choose to plot a polar function that is represented in terms of R. If the function you specify cannot be plotted or contains syntax errors (wrong number of parentheses, etc.) you will get a notice and be returned to the main menu. Remember THAT most functions are indicated by a single letter or character (S for SIN, etc.).

After you have chosen a plotting method (and specified a formula if necessary) you have the option of plotting discreet (separate) or connected points. Then choose a plot color and you can begin plotting. If you have defined a function, the plot will be automatic. If you are plotting interactively, you can change colors in the usual way (connected points will continue to be connected until you return to the main menu). As complicated as this process sounds, a little experimentation will prove that results are easily obtained.

PIE CHARTS- This type of plot requires only that you specify a diameter and color before you can plot. The diameter is indicated in the same way a circle is drawn, by choosing a center point and a point along the radius. Then decide whether the pie is empty or filled, choose a color and the pie is drawn accordingly.

You have the option of drawing simple segments, indicated by lines drawn from the center to the perimeter, or filled segments of a contrasting color. Simple or "empty" segments require only one point to be specified. As you move the cursor horizontally across the tablet, a flashing dot will move around the perimeter of the pie. Press down and a segment will be drawn from the center to that point. If you want to enter values from the keyboard, move the cursor off the LEFT of the screen and press (the palette is off the RIGHT). You can then specify the position of a segment in terms of a percentage of the pie: 12 o'clock is 0 percent, 3 o'clock is 25 percent, etc. If you are plotting full segments, you must specify two points, after which the program will fill in the area in between in the selected color.

THE GALLERY

Most of the functions in this program are ones that you have already encountered in other parts of the system. The only additional function is called "TOUR", which will automatically display all of the pictures on the disk, pausing in between until you press the pen down or recall the menu. Since this program is confined to file manipulation and is so much similar to all of the other file handling procedures in the system, a small tutorial using the Gallery might be useful in acquainting you with the various ways that files can be manipulated.

Let us say that you have been working on a masterpiece of computer art and you want to save it. The only way you can enter the Gallery is from the main program, so you must go there first from wherever you happen to be

in the system. Whenever you enter the Gallery (or any program within the system that handles disk files) the first thing that the program does is load a Directory. The Directory is specially formatted to the kind of information you will be saving: pictures, shape tables, brushes, or animation arrays. A Directory is like the Catalog of the disk except that it is formatted to hold only as many names as the disk will hold of that particular kind of file.

The System disk contains a Directory for each kind of file used in the system. All the spaces in these Directories are empty unless you save something. Since the System disk contains all of the programs used in running the system, there is not very much room on that disk, so there is a means for you to utilize other disks for "off-line" storage. Simply place an initialized disk in Drive 1 and call the Create Directory command. This will place a Directory of the particular kind necessary for the files used by the program you happen to be in on the disk. Remember, there are 4 different kinds of Directories. In our present example, you would take an empty, initialized disk, mark it "Pictures #xx" and place it in the Drive, press "Create Directory", and the system does the rest. This disk can be dedicated to picture storage, or may contain other Directories and files.

You may now save the picture by choosing the "Save" command and titling the picture. But suppose you want to save it with other pictures already on an off-line disk? Before you execute the Save, place the storage disk in the drive and press "Load Directory". Otherwise, the Directory from the System disk will be written out to the storage disk and the system will no longer recognize the names of the pictures stored on that disk! THIS IS VERY IMPORTANT. The system will not do it for you because it cannot tell when you have changed disks (all disks look alike when they are being written to). This is true for all filing operations. If you make a mistake, the Directory Fixer, available from the main menu, should patch things up.

In any case where the system must find something on a disk (LOAD, LOAD DIRECTORY, TOUR, DUMP), it will inform you if it fails to locate what you're looking for. If you want to load a picture from a storage disk, and you have not Loaded it's Directory, you will not be able to find its name in the Directory so you won't be able to load it anyway.

Now suppose you want to load or save a picture on a disk that hasn't been used with the system before. The EXTERNAL command allows you to do this. You can also catalog a disk, and specify either drive 1 or 2 as your source or destination (the System disk, however, will only run on drive 1).

Digitize

This part of the system is nearly identical to the "Distance" and "Area" functions of the original Tablet software, with a few minor changes.

The main difference in the operation of this digitizer (as opposed to the original) is that the measurement is not made until you issue a command by moving the pen off to the right and pressing, as if you were calling the palette. This means you can lift the pen up at any time during the digitizing process and put it down in a different part of the tablet. The pen-up and pen-down positions will be connected automatically. In this way you can specify a distance as a series of points.

Distance: When you choose a measurement function, you have a choice of two pre-calibrated modes (inches or centimeters) as well as a user defined option. The user option is specified in the same manner as with the original software, i.e. draw the distance, name the type of unit, and specify the number of units in the sample.

Area: There is really no difference between specifying a distance and an area. Again, the measurement will not be calculated until you call for it, at which time the first and last points of your figure are automatically connected and any area enclosed by the points specified will be determined.

Animate

This is perhaps the most complex, and most fun part of the entire system. It affords you a method for recording a series of events (up to 100) composed of various techniques collected from other parts of the system. These "animation arrays" can be edited, saved and replayed in a continuous display or one event at a time. This can prove to be not only an entertaining feature, but may be useful as an educative or demonstration tool as well.

Record: Before you can start assembling the events to an animation, you have the option of clearing the array. If you are adding events to a file you have just loaded, you won't want it cleared, but a new animation requires a clean array. You will then be presented with the list of event possibilities.

Draw- This is just the same as Sketch in the Paintbox.

Brush- The list of standard brushes (pixel---dry brush) is displayed and after you've made a choice and set the scale and rotation of the brush, the "Trajectory-Location" option is presented. The Trajectory is a path of points through which the brush will pass. You must also specify a speed at which the brush moves through the Trajectory (high numbers are faster). When the palette appears, there is an extra box labeled "TRACE" at the bottom. If you press here, nothing will happen until you choose a color that will be used to draw the path of the Trajectory (one that will show up on the background). When the recording is replayed, the brush will move through the Trajectory without leaving a trail of "paint" behind it. If you pick a color without touching TRACE first then the brush will leave a trail in that color. Remember, the brush itself is not displayed when you are drawing the Trajectory. "Location" simply places a single image of the chosen brush where the pen is first pressed. If you try to TRACE a location, the brush will flash for an instant and disappear.

Shape- Functionally the same as Brush, but utilizing a user defined shape table. If you have not first issued a "Table" command, nothing will happen when you press here.

Text- You can also add moving lines of text (up to 20 characters) to the animation. Instead of a palette, you have the three types of printing used in the "Label" mode. Black-on-White and White-on-Black will leave trails of type. If you use "Reverse" type then you get the text equivalent of Tracing a brush.

Line- Line segments will be drawn between two endpoints (sorry, no rubber bands!).

Circle- Circles are specified the usual way; center and radius.

Rectangle- The same goes for rectangles. Circles and rectangles can be full or empty.

Fill- Used the same as Fill in Fill In. Be careful! The Edit function can bail you out if things get too messy.

Clear- Erases the screen to the chosen color.

Pause- This function will put everything on hold for the specified number of seconds.

Background- You can load in a previously saved picture as background to your animation. Make sure that the disk containing the picture is in the drive when you go to playback the animation, or you will get an error message that stops everything.

Table- This command loads a directory of shape tables so that one can be utilized in the Shape function. What goes for Background goes for this command as well.

Whenever a function is selected and its parameters determined, the program asks you if you want a replay of the previous events. Of course, as your array gets longer and longer it takes more time to go through all of these events, so in some cases you can save yourself time by skipping the replay. At the bottom of the function list there is a readout of the number of events that have been recorded and how much memory has been consumed. When 100 events have occured or 100% of the memory is used, you will get a warning and the only thing you can do then is Edit or Save that array.

Playback: You have the option of playing the array back without interruption, or having the playback stop after each event (possibly so you can give some verbal explanation to some spectators). In Interrupted mode, a press of the pen will cause the next event to be executed.

Edit: This mode displays its own command line at the bottom of the screen while the events of the array are executed one at a time. Pressing "STEP" cause the next event to run, while pressing "EDIT" causes the remainder of the array, from the current event to the end, to be erased, after which you are returned to the function menu.

Load, Save and Disk: These are the filing command whose operations should be familiar to you, especially if you have read the chapter on The Gallery.

Conclusion

As helpful as this manual may or may not be, there is no better way to get comfortable with the system than to crank it up and play with it for a few hours. Don't set out to make a masterpiece the first time. You will most likely find some little thing you want to explore or fool with to get the hang of it or see what it's possibilities are. There is no way you can hurt the system itself, but you can create a lot of frustration by spending long hours on something and then ruining it by trying some function you think you understand, only to find that it obliterates your hard work.

More than anything else, this system was designed to be oriented toward you, the user, to make it as uncomplicated and as much fun as possible while allowing you the broadest range of control over the graphics hardware. It is hoped that your investment in the Apple and especially the Graphics Tablet will seem more worthwhile through the use of this system.